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ABSTRACT

The pattern of errors of second grade pupils in reading isolated words was analyzed, particularly with respect to reversals of letter sequence and letter orientation. These occurred in significant quantity only among the poorer readers in the class. The two types of reversals were uncorrelated and, therefore, cannot reflect a single process. Sequence reversals were more closely related to other kinds of reading errors than were orientation reversals. The linguistic context as well as optical reversibility of letters is a determinant of confusions in letter orientation. Reading ability assessed by the analytic test composed of isolated words was highly correlated with reading proficiency on a conventional paragraphs test. This suggests that the problems of the beginning reader have more to do with word construction than with strategies for scanning connected text. (Author)

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LETTER CONFUSIONS AND REVERSALS OF SEQUENCE IN THE BEGINNING READER: IMPLICATIONS FOR ORTON'S THEORY OF DEVELOPMENTAL DYSLEXIA[1]

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Reversals of letter order and orientation in reading and writing are generally thought to be of special importance for understanding developmental dyslexia. Interest in reversal errors stems largely from the work of S. T. Orton (1937) who viewed childhood dyslexia as one element of a developmental syndrome which has as its basis an anomaly of cerebral dominance. In forming this neurological conception of reading disability, Orton wished to establish a causal link between two observations: first, that children with reading disability tend to have poorly established or unstable lateral preferences, and secondly, that they tend to reverse letters and words in reading and writing. These difficulties were seen as related manifestations of a failure of one cerebral hemisphere to become dominant. This conception has been challenged by some workers in the field (Schonell, 1948; Burt, 1950; Vernon 1960) and supported by others (Zangwill, 1960; Critchley, 1964). Though an extensive literature has been developed in the area, the question of a possible relation between reading reversals, motor ambilaterality and cerebral dominance remains open.

In our view the question is premature. The significance of reversals in dyslexia is unknown because the reversal phenomenon itself has not been studied systematically and a number of preliminary questions have not been fully answered. In the first place, it is not known how frequently and consistently reversals occur in beginning readers

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generally. Secondly, do reversals comprise a constant proportion of all errors? If so, it would be highly misleading to count the reversals a child makes without examining the other errors as well. Third, are the two types of reversals related? Orton (1937) had differentiated between "kinetic" or sequential reversal of letter order and "static" or orientational reversal of letter form. He did not doubt that they were closely associated, despite his own observation that they "vary markedly in their relative frequence and in the resistance which they offer to eradication by training" (p. 150). The problem of whether these are related phenomena raises a further question: are reversals solely a consequence of optical properties of the letter shapes? This could be true of reversible letters such as *b* and *d*, but another explanation is required to handle reversals of sequences.

Some investigators have viewed reversals in reading as a problem in visual perception, supposing that they are but one indicator of a more general perceptual immaturity, as manifested in such disabilities as poor form and space perception or defective memory for designs. A number of studies (Fildes, 1921; Gates, 1922; Kendall, 1948; Goins, 1958; Malmquist, 1958) have sought relationships between reading proficiency and various aspects of visual perception. The findings of these studies (critically reviewed by Benton, 1962) have been, for the most part, negative or equivocal. The work of Gibson, Gibson, Pick and Osser (1962) has systematically explored the development of the discriminability of letters as optical shapes, by the use of letter-like forms which incorporate the basic features of letters of the alphabet. These researchers have assessed the relative difficulty of various transformations (including reversals) of the basic shapes. Valuable as this developmental study has been in clarifying the visual conditions of letter recognition, it has not dealt with the linguistic function of the letter shapes and, therefore, has limited relevance to our present problem of understanding errors in reading.

In view of these limitations of earlier work, we saw a need for an experimental study of reversal errors which would take into account the linguistic context as well as the optical properties of the stimuli and would investigate reversals in relation to the other errors the child makes when confronted with the printed word.

A number of researchers contemporary with Orton (see, for example, Monroe, 1932; Teegarden, 1933; Gates 1933; Hildreth, 1934; Davidson, 1935; Hill, 1936; Wolfe, 1939; Bennett, 1942) concerned themselves either directly or tangentially with the nature

of reversal errors in reading, but, for various reasons, their results are difficult to assess. Some considered only errors of orientation. Several discussed both types, but did not treat the two separately in presenting their results. When they did consider them separately, they did not investigate further the relationship of the two kinds of error to each other, or their relationships to other consonant and vowel errors occurring concomitantly. Special tests to measure reversal tendency have rarely been devised; most investigators culled the reversals from the children's performance on diagnostic reading paragraphs or word lists. Even when special tests were used, no attempt was made to assess the reliability of the findings or to adjust the observations for the opportunities available in the material for making various types of errors. Some studies took into account the effect of whole-word vs. single-letter presentation; usually, the possibility of different error frequencies in meaningful and nonsense material was not considered.

The same shortcomings listed above are found in more recent explorations of reversal error patterns in reading (Hermann, 1959; Tordrup, 1966). Thus, the relationship of sequence and orientation reversals to each other and to different aspects of reading mastery remains uncertain, as does the nature of the general error pattern in the disabled reader. This investigation was designed to provide a more systematic approach to these questions.

Material and Method

Subjects

The subjects for this study were selected from the second grade of an elementary school system located in a small northeastern Connecticut town. A 60-item word list (described below) was administered to the entire second grade population of the school system (N = 59). Five children were eliminated as possible subjects. These included two with speech impairment, two who moved from the district before testing could be completed, and one who transferred to the school system after the initial segment of testing had begun.

The 18 children chosen for further study comprised the full lower third of the remaining group in reading proficiency as determined by their total error score on the word list. School records indicated that

none of the children had impaired hearing or uncorrected errors of refraction. Fifteen were boys and three were girls. Their ages ranged from 7.25 to 9.25 years (mean = 8.25 years). All tested within the normal range of intelligence according to the Wechsler Intelligence Scale for Children (IQ range: 85 - 126; mean 98.6).

Procedure

The following tasks were given to all the subjects in the same order on successive days.

1. *Word list.* List of 60 real-word monosyllables including a group of primer-level sight words, a group of non-sight words, and word-forming reversals of both types of words, where such were possible. The word list is shown as Table I.

TABLE I

Word List

1. of	21. two	41. bat
2. boy	22. war	42. tug
3. now	23. bed	43. form
4. tap	24. felt	44. left
5. dog	25. big	45. bay
6. lap	26. not	46. how
7. tub	27. yam	47. dip
8. day	28. peg	48. no
9. for	29. was	49. pig
10. bad	30. tab	50. cap
11. out	31. won	51. god
12. pat	32. pot	52. top
13. ten	33. net	53. pal
14. gut	34. pin	54. may
15. cab	35. from	55. bet
16. pit	36. ton	56. raw
17. saw	37. but	57. pay
18. get	38. who	58. tar
19. rat	39. nip	59. dab
20. dig	40. on	60. tip

Each word was printed in manuscript form with a black felt-tip pen on a separate 3″ × 5″ white index card. The cards were presented individually in the order in which they appear in the list in Table I, with the following instructions:

"I want you to read some words aloud for me. Some of the words

are easy, and some are hard. If you don't know the word, try to sound it out. Do the best you can."

Responses were recorded on tape as well as being transcribed during the administration, to check on the accuracy of transcription. Each child's responses were analyzed for reversals of sequence and of orientation, for consonant and vowel errors, and for total errors.

The word list was administered twice to each subject — once at the end of the school year and again in the first week of the following school year. Data from the two presentations were combined in scoring the responses of each subject, but were available separately for assessment of test-retest reliability.[3]

2. *Gray Oral Reading Test, Form A.* Administered by the standard procedure. Raw paragraph scores based on Gray's system of weighting time and number of errors were used to evaluate the subjects' performance, rather than grade level equivalents.

3. *Single-letter presentation* (*Tach.*). List of 100 items in which a given letter was to be matched to one of a group of five, including four reversible letters in manuscript form (*b, d, p, g*) and one non-reversible letter (*e*) which was added as a reliability check. There were 20 such items for each letter. The order of the resultant 100 items was randomized, as was the order of the multiple-choice sequence for each item on the answer sheet. The standard was presented tachistoscopically for matching with one of the multiple-choice items on the answer sheets. Tachistoscopic exposure of the 2″ × 2″ slides of each letter was projected for 1/125 sec. in the center of a 9″ × 12″ screen mounted six feet in front of the subject. A brief training session was provided for each child.

Error analysis of word transcription

The responses to the stimulus words were scored twice — first, from the transcription made at the time of the test administration, and second, from a separate transcription by another experimenter

[3] A nonsense list consisting of 60 CVC nonsense monosyllables was also administered to this group. Full discussion of this task will be reserved for a later paper, but certain of the data will be included here, where pertinent. Administration was the same as for the word list except for the instructions, which were as follows: "Here are some make-believe words. They are not real words; they are only pretend words. Read them aloud as well as you can."

from the tape recording. Disagreements between scores were infrequent and were easily settled by invocation of the rules listed below.

1. *Reversal of sequence* (*RS*). Scored when a word or a part of a word was read from right to left (e.g., when *lap* was read as [pæl] or [pleI]; *form* as [fram]).

2. *Reversal of orientation* (*RO*). Scored when *b, d, p,* and *g* were confused with each other, as when *bad* was read as [dæd], [pæd], or [bæg]. If *bad* was given as [dæb], it was scored as a sequence error instead. Both types of reversal were scored when *nip* was read as [bIn].

3. *Other consonant error* (*OC*). Included all consonant omissions and additions as well as all consonant substitutions other than reversal of orientation. A response could contain both a sequence reversal and a consonant error, as in the case of the response [træp] for the stimulus word *pat*. It could also contain both an orientation reversal and a consonant error, as in the case of the response [træp] for the stimulus word *tab*. However, confusions among *b, d, p,* and *g* were scored only as reversals of orientation, not as consonant errors.

4. *Vowel error* (*V*). Included all vowel substitutions, such as [pIg] for *peg*. A vowel error was not charged when a consonant error in the response forced a change in the pronunciation of the vowel, provided the vowel sound produced in the response was a legitimate pronunciation of the original printed vowel (response [ræt] for the stimulus word *raw*).

5. *Total error*. Simply the sum of all the preceding error types.

In general, the first concern was to assure that scoring was not falsely prejudiced in the direction of any given error category. To this end, certain additional rules were consistently invoked in the few instances when scoring was not immediately self-evident. The stimulus word was viewed in relation to its component printed vowels and consonants as written. The response word was considered phonetically, not in terms of the orthographic transcription of a possible target word. An exception was made when both the stimulus and target contained vowel digraphs. As noted above,

no vowel error was charged when a consonant error in the response produced a change in the pronunciation of the vowel, provided the original printed vowel would be sounded legitimately as read in its new consonant environment.

Several examples may serve to clarify the scoring. If *tar* was read as [tra], it was, of course, scored simply as a sequence reversal. If it was read as [treI], the response was scored as both a sequence reversal and a vowel error. Here no account was taken of the possible target word *tray*. The response [træp] would have been scored as a sequence reversal and a consonant error (for the addition of the *p*). In this case, no vowel error would be scored, since the original printed vowel would be sounded in this way in its new consonant environment (caused by the addition of the *p*).

Where the final consonant of the stimulus word was part of a vowel digraph as in the case of the word *raw*, substitutions for the *w* were viewed as consonant errors (e.g., *raw* read as [ræt] or [ræm]). Here, as was the case of [træp] as a response for *tar*, no vowel error was charged, since both the stimulus word and the possible target word (ray) involved vowel digraphs ([ɔ] and [eI]).

Results

Which children reverse?

The entire second grade group was rank-ordered with respect to frequency of total errors on the word list. Nearly all of the reversal errors were found in children ranking in the lower third of the distribution. We, therefore, confined our study to these 18 children who comprised the poorest readers.

It was apparent that for most of the children, reversals accounted for only a rather small proportion of the total of misread letters. The means (as percentages of the total error) were 10% and 15% respectively, for RS and RO, whereas other consonant (OC) errors accounted for 32% of the total and vowel (V) errors for 43%. Even among this group of poor readers, individual differences were fairly large: rates of RS ranged from 4%-19%; rates of RO ranged from 3%-32%. Thus it is clear that among poor readers reversals do not merely form a constant proportion of all errors: only some

poor readers reverse. Certainly it is important to explore the other differences among children who do and do not make reversals of sequence and orientation.

Test - retest reliability

Since our method of reading assessment was untried, we were concerned to demonstrate its reliability. The test-retest reliability coefficient for the total error was .83; for OC errors, .69; for V errors, .64. Thus the general error rate among the children is stable, although they tend to give some redistribution of the errors among consonants and vowels. Both types of reversal errors give lower reliability coefficients (r_{12} = .43 for RS; r_{12} = .50 for RO), indicating that they are not highly stable error categories.

The word list and reading fluency

Having presented our second grade readers with a highly artificial task of reading monosyllabic words in isolation, we wished to know how performance on such a task related to a conventional measure of reading proficiency. For that purpose we selected the Gray's Oral Reading Test as the most appropriate test available. The obtained Pearson product-moment correlation coefficient (r) was .77 between total errors on our word list and score on Gray's paragraphs demonstrating a high relationship between error rates on isolated words and on connected text. This finding suggests that the problems of the beginning reader have more to do with the organization of syllables than with the scanning of larger chunks of text. If the subjects had done well on the word list, but poorly on the paragraphs, difficulty in scanning a line of text might have been implicated. Since performance on the connected text was so highly correlated with that on isolated words, the major source of difficulty for these children must be in decoding the words. Of course, decoding may not be the most important problem for poor readers at later stages of reading development.

Intercorrelations among the various measures are displayed in Table II. As a further indication of the stability of the major error categories computed from the word list, it is noteworthy that the OC error category correlated .73 with V errors and each correlated well with the independent measure of reading proficiency, the

TABLE II

Intercorrelation Matrix

	Reversed sequence errors	Reversed orientation errors	Other consonant errors	Vowel errors	Single letter (tach.) errors	Gray paragraphs	WISC IQ
Total errors	**73	28	**93	**91	19	**77	*56
RS errors		03	**72	*56	14	45	34
RO errors			09	20	04	15	17
OC errors				**73	28	**71	*46
V errors					08	**75	**59
Tach. errors						01	16
Gray's Oral							38

Note. - The table contains Pearson product-moment correlation coefficients. Decimal points are deleted.

* $p < .05$

** $p < .01$

Gray paragraphs (OC errors × Gray paragraphs, r = .71; V errors × Gray paragraphs, r = .75).

Lack of correlation between the two types of reversals

Although Orton (1937) distinguished between reversals of letter sequence and letter orientation, he and his successors tended to assume that both are manifestations of the same underlying disturbance, namely, a failure to develop a consistent automatic left-to-right pattern of scan. Having considered the two types of reversals separately, we find no support whatever for supposing that they have a common cause: RS and RO were wholly uncorrelated (r = .03).* That means, of course, that an individual's frequency of misordering letter sequences is entirely unpredictable from his frequency of confusing geometrically ambiguous letters.

The two types of reversals, moreover, correlate quite differently with other measures. Inspection of the matrix of intercorrelations (Table II) reveals that RS is significantly correlated with OC and

* After preparation of this manuscript was completed, we discovered a study by Lyle [Lyle, J. G. (1969) *Reading retardation and reversal tendency: a factorial study*, "Child Development," *40*, 833-843] in which, in agreement with our findings, an absence of correlation between RS and RO was noted.

V, whereas neither of these is significantly correlated with RO. There is then clearly no justification for grouping the two types of reversal errors together.

Reversals in relation to other errors

Table III gives frequencies of errors (for RS, RO, OC, and V) each percentaged according to the opportunities for errors of that type. This tabulation permits us to compare the relative frequencies of the various types of errors. First, we see, in agreement with classroom experience, that letters representing vowels are far more often

TABLE III

Errors as a Function of Opportunity

	Reversed sequence	Reversed orientation	Other consonant	Vowel	Single letters (tach.)
Errors	136	202	447	598	133
Opportunities	2160	1584	2736	2232	1800
Percent	6.3	12.7	16.3	26.8	7.4

misread than consonants. Reversals of orientation (RO) have a greater relative frequency of occurrence than sequence reversals (RS), but less than other consonant errors (OC)[4]. It is important to note that the problem with reversible letters is specific to reading words: when the task is to identify these letters individually, even at rapid exposures, few errors occurred (mean = 7.4%). Clearly then, the fact that these letters are a special source of difficulty in reading cannot be regarded simply as a problem in form perception.

Reversed orientation of letters: the nature of the confusions

It is of some interest to examine closely the particular confusions among letters which are formed by 180-degree transformations of the same basic shape. Confusions among the four reversible letters are

[4] RO in Table III is lowered by the inclusion of *g*, which, as shown in Table IV, produces very few confusions with *b*, *d*, or *p*. When based only on these three truly reversible letters, RO increases to 15.5%.

presented as a matrix in Table IV. The matrix shows, with respect to each letter, the frequency with which it was replaced by another letter. Each row in the matrix refers to letters occurring in the word list and each column refers to the responses given by the children in oral reading. These frequencies are expressed as percentages of the total occurrences of each letter in the list (i.e., in terms of opportunities for error).

TABLE IV

Confusion Among Reversible Letters in Word List. Percentages Based on Opportunities

Presented \ Obtained	b	d	p	g	Total reversals	Other errors
b	....	10.2	13.7	0.3	24.2	5.3
d	10.1	....	1.7	0.3	12.1	5.2
p	9.1	0.4	....	0.7	10.2	6.9
g	1.3	1.3	1.3	....	3.9	13.3

Confusion of *b* and *d* is the reversal most commonly mentioned in the literature and was interpreted by Orton (1937) as an instance of "sinistral" scan. It will be seen from Table IV, however, that in this group of children, *p* is given for *b* more frequently than is *d*. Indeed, in the table as a whole, there were slightly fewer occurrences of 180-degree transformations in the horizontal plane (*b* to *d*, for example) than in the vertical plane (*b* to *p*, for example). This does not support the view that letter reversals are attributable to reversed direction of scan.

We also learn from the table that errors are essentially confined to confusions among *b*, *d* and *p*. The letter *g* is, of course, a distinctive shape in all type styles, but it was included among the reversible letters because, historically, it has been treated as a reversible letter. It indeed becomes reversible when hand printed with a straight segment below the line. (Even in manuscript printing, as was used in preparing the stimulus materials for this study, the tail of the *g* is the only distinguishing characteristic.)

Concerning the confusions among *b*, *d*, and *p*, the truly reversible consonants, most errors involved a single 180-degree transformation about the vertical axis or the horizontal axis, but not both. Presumably,

the presence within the alphabet of equivalent or near-equivalent optical shapes is one determinant of confusions among the letters *b*, *d*, *p*, and, by the same reasoning, the lack of congruence between these and *g* accounts for the rarity of the *g* substitution for *b*, *d*, or *p*. This conclusion is also supported by the relatively small frequencies of nonreversal errors (i.e., substitutions outside the set defined by the matrix) for *b*, *d*, and *p* in contrast to *g*.

Can we make sense of the pattern of the actual distribution of errors among the letters which differ in orientation but not in form? Table IV shows that at least twice as many errors occurred on *b* as on *d* or *p*. We may speculate on why this should be so. It may be relevant that *b* offers two opportunities to make a single 180-degree transformation, whereas *d* and *p* offer only one. But there could also be a phonetic reason for the greater error rates on *b*, in that it offers the reader two opportunities to err by a single articulatory feature (place or voicing) whereas *d* and *p* offer only one opportunity to make a single feature error. This would be consistent with the finding that errors in perception of spoken consonants tend to differ from the presented consonant in only one feature (Miller and Nicely, 1955).

The present study gives no clear basis for choosing between these alternative interpretations.

We had also presented to the same children a list of pronounceable nonsense syllables with instructions that these were "pretend" words and that the children should attempt to sound them out as best they could. As expected, many more errors occurred on these than on real words, and the children tended to err by converting a nonsense syllable into a word.* Again, *g* was rarely confused with the other three. However, the distribution of *b* errors was different from that which has been obtained with real words in that *b* - *p* confusions occurred only rarely. A check of the number of real words that can be made by reversing *b* in the two lists revealed no fewer opportunities to make words by substitution of *p* than by substitution of *d*, indeed, the reverse was the case. This result suggests that the nature of

* When children read real words, their errors also are directed toward producing real words. Furthermore, an examination of the error distribution by individual words in the list shows that errors are concentrated on words where a well-known word is available as an error possibility. This tendency seems to affect the production of both RS and RO. However, since our stimulus list was not designed to investigate this factor specifically, we will postpone further speculation on the mechanisms involved for future research.

substitutions even among reversible letters is context dependent and therefore not an automatic consequence of the propert of optical reversibility.

We may then ask whether confusions among *b*, *d*, and *p* occur outside of word context. When reversible letters were presented tachistoscopically as isolated shapes, relatively few misidentifications occurred (see Table III) and, moreover, RO and Tach. are uncorrelated (Table II). Thus, the characteristic of reversibility is not a sufficient condition for confusion.

We may conclude that, for whatever reason, *b* is significantly more often misread than other consonants. The fact that the errors on *b*, *d*, and *p* tend to be confusions within the set suggests that the possibility of generating another letter by simple 180-degree transformation is a relevant factor in producing this high error rate. On the other hand, we have seen that ROs are, as are OC and V errors, context dependent and thus reflect the workings of linguistic processes as well as purely visual ones.

Discussion

Reversals of letter sequence and letter orientation occurred in significant quantity only among the poorer readers in our groups of second graders. Even within the lower third of the class, they accounted for only 10% and 15%, respectively, of the total of misread letters, whereas other consonant errors accounted for 32% of the total and vowel errors accounted for 43%. Viewed in terms of opportunities for error, RO occurred less frequently than other consonant errors. Test-retest comparisons showed that whereas other reading errors are rather stable, reversals, and particularly RO, are unstable. Individual differences in reversal tendency were also large. Thus the indications from the analysis of variability, both intrasubject and intersubject, are that reversals do not form a constant proportion of all errors; only certain poor readers reverse, and it will be important to explore other differences between children who do and do not have reversal problems.

Although we have stressed that reversals of either type do not account for a large proportion of the total error in most of the children we have studied, it may be that reversals loom larger in importance

in certain children with particularly severe and persisting reading difficulty. Our clinical experience suggests that this may be so and we intend to explore the question in future research.

Examination of the intercorrelations among various reading errors showed that the two types of reversals are wholly uncorrelated. This is a finding of considerable interest since both were considered by Orton and subsequent investigators to be manifestations of an underlying tendency to reverse the direction of scan. That view cannot easily be reconciled with two additional findings: first, among reversible letters, vertical reversals occurred with as great frequency as horizontal reversals. Second, confusions among reversible letters rarely occurred when these letters were presented singly, even when briefly exposed.

We investigated the relationship between reversals of both types and other errors in reading syllables. The findings are clear-cut: individual error rates on vowels and consonants correlated highly with each other (another indication of the stability of our test) and each also correlated highly with the Gray's Oral Reading Test, an independent measure of reading proficiency. Frequency of RS correlated moderately with frequencies of other errors in reading the words and with the independent measure of reading proficiency, whereas RO frequency yielded weak and nonsignificant correlations with every other measure.

An analysis of the nature of substitutions among reversible letters (*b*, *d*, *p*, *g*) was carried out. This showed that the possibility of generating another letter by a simple 180-degree transformation is a relevant factor in producing a relatively high rate of confusion among these letters, in agreement with conclusions reached by Davidson (1935) and by Gibson and her associates (1962).

At the same time, other observations indicate the importance of linguistic determinants: differences in the pattern of confusions among *b*, *d*, *p*, and *g* in real words and nonsense words show that misperceptions even of reversible letters are context dependent and not merely an automatic consequence of optical reversibility. Moreover, the substitutions tended to differ from the presented consonant in one phonetic feature. Finally, relatively few confusions of these letters occurred when they were presented in isolation rather than in word context. All of these observations point to the conclusion that the characteristic of reversibility is not by itself a sufficient condition for confusion. (See Kolers, 1970, for a general discussion

of how perception of letters and words differs from perception of nonlinguistic forms).

Further exploration of the linguistic determinants of children's reading errors is likely to be profitable. In this connection, the high correlation between reading proficiency on the word list and the paragraphs of the Gray's Oral Reading Test suggests that for the beginning reader, at least, an analytic test consisting of monosyllables can be substituted for a test employing connected text. We consider this an important finding because it indicates that a major part of the difficulty of the beginning reader has to do with the rules governing the synthesis of syllables from combinations of letter segments, rather than with strategies for scanning connected text.

This conclusion is supported by the results of a direct comparison of rate of scan in good and poor reading children (Katz and Wicklund, 1971; see also Sternberg, 1967). It was found that both good and poor readers require 100 msec. longer to scan a three-word sentence than a two-word sentence, indicating that both have equivalent scanning rates and suggesting that they differ instead in some aspect of the decoding process.

Summary

The pattern of errors of second grade pupils in reading isolated words was analyzed, particularly with respect to reversals of letter sequence and letter orientation. These occurred in significant quantity only among the poorer readers in the school class. The two types of reversals were uncorrelated and, therefore, cannot reflect a single process as Orton had implied. Sequence reversals were more closely related to other kinds of reading errors than were orientation reversals. The linguistic context as well as optical reversibility of letters is a determinant of confusions in letter orientation. Reading ability assessed by the analytic test composed of isolated words was highly correlated with reading proficiency on a conventional paragraphs test. This suggests that the problems of the beginning reader have more to do with word construction than with strategies for scanning connected text.

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